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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se référer à la description.)

Method of recording on a dual layer record carrier, and device for recording on a
dual layer record carrier

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Method of recording on a dual layer record carrier, and device for recording on a dual layer record carrier

The invention relates to a method of recording information on a recordable multi-layer record carrier, such as a dual layer DVD disc. The invention further relates to a recording device in which the above method is implemented.

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DVD-ROM discs are well known. This read-only type of record carriers is used for storing large amounts of information, such as for example digitally encoded movies. To be able to store even larger amounts of information, a record carrier may comprise multiple information layers, that is layers in which the information is stored in the form of optically detectible areas. Dual layer DVD-ROM discs, comprising two information layers, are currently well known.

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Recordable DVD discs, both the write-once type (such as DVD+R) and the rewritable type (such as DVD+R/W), are used for recording large amounts of information. Recently, dual layer versions of these recordable DVD discs have been introduced.

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A dual layer disc comprises two information layers, generally referred to as the L0 and L1 layers. The L0 layer is the information layer located closest to the side of a disc where a radiation beam, such as a laser beam, used for reading and/or recording the information enters the disc.

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The information is stored on these record carriers according to specific rules and layouts, generally referred to as Formats, which are described in documents referred to as a Standards.

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It is a problem that the information recorded on a dual layer recordable DVD disc cannot always be reproduced on a DVD-ROM player without errors. This, so-called compatibility issue, is especially a problem since a large installed base of DVD-ROM players is already available all around the world.

It is an object of the present invention to provide a method of recording a dual layer recordable DVD disc in such a way that it can be reproduced in DVD-ROM players without errors.

This object is achieved by the method according to the present invention wherein information is incrementally recorded on the disc such that the amount of information written on layer L0 is substantially equal to that written on layer L1.

It was observed that the compatibility problem arises in two cases: 1) when the data is placed entirely on only one information layer, or 2) when the data is placed on both layers, with layer L0 totally filled and layer L1 only partially filled. It appeared that these two cases are non-compliant with the DVD-ROM Standard because: 1) The DVD-ROM standard states that the information area on the information layer L0 must be about the same size as the information area on the information layer L1, and/or 2) when a drive accesses the beginning of information layer L1 (located at the outside of the disc) it will first jump to layer L1 and then move its tray outwards. However, if the area to which it jumps is unwritten, a drive will most likely crash.

According to the present invention this compatibility problem is solved by modifying the Format of the recordable DVD discs in such a way that a method of recording information has the possibility to incrementally fill the disc with information such that the amount of information written on layer L0 is substantially equal to that written on layer L1.

However, the current Format does not support such an incremental filling process because once an application writes to layer L1 and makes its written area just as large as the written area on layer L0, then the disc is considered full and no information can be added anymore.

L1	SClosure	User Data of Session1	Middle zone
L0	Sintro	User Data of Session 1	Middle zone

This is because the Logical Address is zero at the beginning of layer L0 and increase linearly to the end of layer L0 up to the Middle zone, and then increases linearly on L1 starting at the Middle zone to the lead-out (SClosure). Hence, all of the blocks in the

Middle zone are lost (that is, unavailable for recording information). Preferably, these blocks should be available for recording information.

The basic obstruction in the Format is that it only allows sequential recording in Fragments and Sessions. This means that one could skip over a large area on layer L0 by declaring a Fragment. However, this entire Fragment must be written before the disc is closed. This is because all Fragments in a Session must be closed before closing a Session, and only recordable discs with closed Sessions are DVD-ROM compliant.

According to the present invention a Fragment is allowed to remain open after closing a Session. By allowing the Fragment to remain open after closing the Session, it is made a special type of Fragment. Therefore it is referred to as a Hierarchical Fragment. It is hierarchical because it is contained within a Fragment and may contain itself other Fragments. Furthermore, it is a Fragment which itself contains all of the information needed to register all new Fragments, and again hierarchical Fragments, it may contain.

According to an embodiment of the invention, a Session has the layout

15	<table><tr><td>Sintro</td><td>Zero or more Fragments or Hierarchical Fragments</td><td>SClosure</td></tr></table>	Sintro	Zero or more Fragments or Hierarchical Fragments	SClosure
Sintro	Zero or more Fragments or Hierarchical Fragments	SClosure		

and a Fragment has the layout

20	<table><tr><td>User Data</td></tr></table>	User Data
User Data		

Now, a Hierarchical Fragment has the layout

Fintro	Zero or more Fragments or Hierarchical Fragments	FClosure
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This can be distributed over a dual layer disc as:

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SClosure	User Data of Session1	FClosure	
Sintro	User Data of Session 1	Fintro	

When such a dual layer disc is viewed upon as a linear address range, this would look like:

Sintro		Fintro	Fragments or Hierarchical Fragments	FClosure	SClosure
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Hence, the Hierarchical Fragment is embedded within the session. This enables the user to leave a track within a Session open. This becomes possible due to the fact that a track contains its own administration area. Now, it is possible for a disc drive to read what has been written and what has not been written. Preferably, a DVD-ROM drive performs a Hierarchical Fragment search to find the number of such Fragments and to determine whether or not they are completely written.

SClosure		FClosure		FClosure		FClosure
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Sintro		Fintro		Fintro		Fintro
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Above an example is shown of an embodiment comprising a hierarchy of three Hierarchical Fragments. Because the disc is filled linearly from the inner radius (on the left) to the outer radius (on the right), it remains DVD-ROM compliant. The logical addresses run linearly over the entire disc. Hence, within a closed Session or a closed Hierarchical Fragment there may be address zones that have not been written yet. However, a DVD-ROM drive will not have any problems with these unwritten addresses because a drive will jumping the layers and not going to the end of one layer before jumping to the next.

A device according to the present invention is capable of executing the above-described method according to the invention. Preferably, next to the supported commands for reserving tracks, inquiring about their sizes, and closing sessions, support for commands like 1) Reserve Hierarchical Track, 2) Get Hierarchical Track Information, and 3) Close Hierarchical Track is implemented.

CLAIMS:

1. Method of recording information on a recordable multi-layer record carrier, said record carrier comprising a first information layer and a second information layer for storing the information, wherein information is incrementally recorded on the disc such that the area regarded as containing written information on the first information layer is
5 substantially equal to the area regarded as containing written information on the second information layer.

2. Method according to claim 1, wherein the area regarded as containing written information on the first information layer and/or the area regarded as containing written
10 information on the second information layer comprise an area where no information is recorded.

3. Recording device for recording information on a recordable multi-layer record carrier operative for executing a method as claimed in claim 1 or 2.
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ABSTRACT:

The invention relates to a method and device for recording information on a recordable multi-layer DVD disc wherein information is incrementally recorded on the disc such that the area regarded as containing written information on the first information layer is substantially equal to the area regarded as containing written information on the second
5 information layer. In this way a recordable disc is produced from which DVD-ROM players can retrieve the recorded information.